

CLAIMS

1. A stress measuring method characterized by comprising an electron beam irradiating process that irradiates an electron beam on a specimen,
5 a spectroscopy process that analyses light generated from the specimen by the above-mentioned electron beam irradiating process and obtains a spectrum, and a stress calculating process that obtains a stress change based on a spectrum shift between a spectrum obtained from
10 the specimen in a predetermined state and a spectrum obtained from the specimen in a state different from the predetermined state.
2. The stress measuring method described in claim 1 and
15 characterized by that a residual stress is obtained in the above-mentioned stress calculating process based on a spectrum shift between a specimen spectrum as being a spectrum in a state that no stress exists in the specimen and a stress impressed spectrum as being a spectrum in a
20 state that a residual stress exists in the specimen.
3. The stress measuring method described in claim 1 or 2, and characterized by that
an external force impressing process that applies an
25 external force to the specimen prior to the above-mentioned electron beam irradiating process is further provided, and an internal stress is obtained in the above-mentioned stress calculating process based on a spectrum shift between an

internal stress impressed spectrum as being a spectrum in a state that an internal stress is generated in the specimen by the external force impressing process and a specimen spectrum as being a spectrum in a state no stress exists in the specimen or a stress impressed spectrum as being a spectrum in a state that a residual stress exists in the specimen.

4. The stress measuring method described in either one of claim 1 through claim 3, and characterized by that the above-mentioned electron beam irradiating process includes a broad area electron beam irradiating process that irradiates an electron beam without narrowing down on a broad area that is broad enough compared with a spot size of the electron beam that is narrowed down to obtain a requested space resolution, and in the stress calculating process a spectrum obtained by analyzing light generated from the specimen by the broad area electron beam irradiating process is made to be a specimen spectrum as being a spectrum in a state that no stress exists in the specimen.

5. The stress measuring method described in either one of claim 1 through claim 3, and characterized by that the above-mentioned electron beam irradiating process includes a broad area electron beam irradiating process that irradiates an electron beam on a broad area that is broad enough compared with a spot size of the electron beam that

is narrowed down to obtain a requested space resolution with scanning the spot size, and

in the stress calculating process an average of spectra of light generated by irradiating each electron beam in the

5 broad area electron beam irradiating process is made to be the specimen spectrum as being the spectrum in the state that no stress exists in the specimen.

6. The stress measuring method described in claim 4 or claim
10 5, wherein the above-mentioned broad area is all area of the specimen.

7. The stress measuring method described in claim 4 or claim
5, wherein a diameter of the above-mentioned broad area is
15 set as not less than 100 times of the spot size of the electron beam that is narrowed down so as to obtain the required space resolution.

8. The stress measuring method described in either one of
20 claim 1 through claim 3, and characterized by that a minute amount sample obtaining process that obtains a minute amount of a sample from the specimen is further included, and
in the stress calculating process a spectrum of light
25 obtained by irradiating an electron beam on the minute amount sample is made to be a specimen spectrum as being a spectrum in a state that no stress exists in the specimen.

9. The stress measuring method described in either one of claim 1 through claim 8, and characterized by that a composition analyzing process that analyzes a partial difference of composition of the specimen is further
5 included, and
in the above-mentioned stress calculating process the above-mentioned specimen spectrum is determined for each area where composition of the specimen differs obtained by the above-mentioned composition analyzing process in
10 consideration of a spectrum shift generated due to the difference of composition.

10. The stress measuring method described in either one of claim 1 through claim 9, wherein
15 external light whose spectrum is known is irradiated in the above-mentioned electron beam irradiating process,
a spectrum of the external light and a spectrum of light emission from the specimen are obtained in the above-mentioned spectroscopy process, and
20 each position of spectra from the specimen in each state to be compared in order to measure a stress change is compensated based on the spectrum of the external light in the above-mentioned stress calculating process.

25 11. The stress measuring method described in claim 10, and characterized by that a position of a spectrum of a specimen spectrum as being the spectrum in the state that no stress exists in the specimen and a position of a spectrum of the

stress impressed spectrum as being a spectrum in a state that a residual stress exists in the specimen are compensated respectively based on a spectrum of external light in the above-mentioned stress calculating process.

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12. The stress measuring method described in claim 10 or claim 11, and characterized by that a position of a spectrum of an internal stress impressed spectrum as being a spectrum in a state that an internal stress exists in the specimen and a position of a spectrum of a specimen spectrum as being a spectrum in a state that no stress exists in the specimen or a position of a spectrum of the stress impressed spectrum as being a spectrum in a state that a residual stress exists in the specimen are compensated respectively based on a spectrum of external light in the above-mentioned stress calculating process.

13. The stress measuring method described in claim 10 or claim 11, wherein a predetermined peak wavelength as being a reference for the above-mentioned external light spectrum is set near a predetermined peak wavelength for the light emission spectrum from the specimen.

14. The stress measuring method described in either one of claim 1 through claim 13, and characterized by that a correlation calculating process that calculates a correlation between an amount of external force impressed on the specimen and an amount of the above-mentioned spectrum

shift is included prior to the above-mentioned stress calculating process.

15. The stress measuring method described in either one of
5 claim 1 through claim 14, and characterized by that the above-mentioned specimen includes at least one kind of an element selected from a family consisting of lanthanoid by an amount within a range of 1 ppm ~ 10000 ppm.

10 16. The stress measuring method described in claim 15, and characterized by that the above-mentioned lanthanoid is at least one element selected from a family consisting of Sm, Eu, Tb, Y, La, Er, and Gd.

15 17. A stress measuring device characterized by comprising an electron beam irradiating means that irradiates an electron beam on a specimen,
a spectroscopy means that analyzes light generated from the specimen by the electron beam irradiating means so as to
20 obtain a spectrum, and
a stress calculating means that obtains a stress change generated in the specimen based on a spectrum shift between a spectrum obtained from the specimen in a predetermined state and a spectrum obtained from the specimen in a state
25 different from the predetermined state.

18. The stress measuring device described in claim 17, and characterized by the above-mentioned stress calculating

means is to obtain a residual stress based on a spectrum shift between a specimen spectrum as being a spectrum in a state that no stress exists in the specimen and a stress impressed spectrum as being a spectrum in a state that a
5 residual stress exists in the specimen.

19. The stress measuring device described in claim 17 or claim 18, and characterized by that an external force impressing means that applies an external force to the
10 specimen is further provided.

20. The stress measuring device described in claim 19, and characterized by that the above-mentioned stress calculating means is to obtain an internal stress from a spectrum shift
15 between an internal stress impressed spectrum in a state that the internal stress is generated in the specimen by the external stress impressing means and the above-mentioned specimen spectrum or the above-mentioned stress impressed spectrum.

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21. The stress measuring device described in either one of claim 17 through claim 20, and characterized by that a minute amount sample obtaining means that obtains a minute amount of sample from the spectrum is further provided.

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22. The stress measuring device described in either one of claim 17 through claim 21, and characterized by that a composition analyzing means that analyses a partial

difference of composition of the specimen is further provided.

23. The stress measuring device described in either one of
5 claim 17 through claim 22, and characterized by that an
external light irradiating means that irradiates external
light whose spectrum is known is further provided.

24. The stress measuring device described in either one of
10 claim 17 through claim 23, and characterized by that a
visualizing means that visualizes a portion to be measured
of the above-mentioned specimen is further provided.

25. The stress measuring device described in either one of
15 claim 17 through claim 24, and characterized by that a
diameter of a beam spot of an electron beam irradiated by
the above-mentioned electron beam irradiating means is not
more than 100 nm.

20 26. The stress measuring device described in either one of
claim 17 through claim 25, and characterized by that the
above-mentioned electron beam irradiating means is a
scanning electron microscope.

25 27. A stress measuring device characterized by comprising
a light irradiating process that irradiates irradiating
light on a specimen,
a spectroscopy process that analyzes light generated from

the spectrum by the above-mentioned light irradiating process so as to obtain spectrum, and
a stress calculating process that obtains a stress change generated in the specimen based on a spectrum shift between
5 a spectrum obtained from the specimen in a predetermined state and a spectrum obtained from the specimen in a state different from the predetermined state, wherein the light irradiating process includes a broad area light irradiating process that irradiates irradiating light
10 without narrowing down the irradiating light on a broad area that is broad enough compared with a spot size of the irradiating light that is narrowed down to obtain a requested space resolution, and
in the above-mentioned stress calculating process a spectrum
15 obtained by analyzing light generated from the specimen by the broad area light irradiating process is made to be a specimen spectrum as being a spectrum in a state that no stress exists in the specimen.

20 28. The stress measuring device characterized by comprising a light irradiating process that irradiates irradiating light on a specimen,
a spectroscopy process that analyzes light generated from the spectrum by the above-mentioned light irradiating
25 process so as to obtain spectrum, and
a stress calculating process that obtains a stress change generated in the specimen based on a spectrum shift between a spectrum obtained from the specimen in a predetermined

state and a spectrum obtained from the specimen in a state different from the predetermined state, wherein the above-mentioned light irradiating process includes a broad area light irradiating process that irradiates

5 irradiating light on a broad area that is broad enough compared with a spot size of the irradiating light that is narrowed down to obtain a requested space resolution with scanning the spot size, and

10 in the above-mentioned stress calculating process an average of spectra of light generated by irradiating each irradiating light in the broad area light irradiating process is made to be a specimen spectrum as being a spectrum in a state that no stress exists in the specimen.